TSG-RAN Working Group 1 meeting #10 **_TSGR1-00-0012_**
Beijing, China, 18th - 21st , Jan., 2000

Agenda Item :

Source : LG Information & Communications, Ltd.

Title : CR 25.214-043 ; Optimum ID Codes for SSDT Power Control

Document for : Approval

1. Introduction

Site selection diversity transmit (SSDT) is an optional macro diversity method to reduce the multiple transmission in a soft handover mode [1]. In order to select a primary cell, each cell is assigned a temporary identification (ID) and UE periodically informs a primary cell ID to the connecting cells. The non-primary cells selected by UE switch off the transmission power. The primary cell ID is delivered by UE to the active cells via uplink FBI field. Each cell is given a temporary ID during SSDT and the ID is utilized as site selection signal. There are three different lengths of coded ID available denoted as "long", "medium" and "short".

At the last meeting in Dresden, a couple of contributions regarding optimum cell ID codes for SSDT power control were proposed. The new SSDT cell ID codes of [2] were optimized in terms of the minimum Hamming distance and thus the significant performance gain was found in AWGN as well as in Fading channel. Although [2] was almost accepted in Ad hoc 9, there was no conclusion on this issue since a concern regarding simulation assumption was raised. To clarify this concern, Ad hoc 9 decided to send liaison to WG3. Thus LGIC and Samsung made liaison [3] together and the approved liaison [4] from WG1 was sent to WG3. According to the response liaison from WG3 [5], it was proved that the simulation results of [2] were correct since the dynamic SSDT allocation is not supported by WG3 and node B does not know whether UE is in the soft handover or not.

In this contribution we add some simulation results to [2] in Fading channel of 120km/h, and we also see the similar performance gain. The short SSDT cell ID code of 1 bit FBI of this contribution is different from that of [2] and the proposed codes are designed to maximize the commonality among the codes. The decoder can be easily implemented using the property of FHT (Fast Hadamard Transformation) and the SSDT cell ID codes are designed to have high commonality among the codes. We therefore conclude that the current ID codes [1] for SSDT should be replaced with the proposed ones. This document request the change of ID codes for 1 bit FBI and 2 bit FBI in 5.2.1.4 of TS 25.214.

2. Current ID Codes

There are three different lengths of coded ID available denoted as "long", "medium" and "short". The network decides which length of coded ID is used. Settings of current ID codes for 1-bit and 2-bit FBI are exhibited in table 1 and table 2, respectively.

Table 1: Settings of ID codes for 1 bit FBI (CURRENT)

	ID code		
ID label	**"long"**	**"medium"**	**"short"**
A	000000000000000	0000000(0)	00000
B	111111111111111	1111111(1)	11111
C	000000001111111	0000111(1)	00011
D	111111110000000	1111000(0)	11100
E	000011111111000	0011110(0)	00110
F	111100000000111	1100001(1)	11001
G	001111000011110	0110011(0)	01010
H	110000111100001	1001100(1)	10101

Table 2: Settings of ID codes for 2 bit FBI (CURRENT)

	ID code (Column and Row denote slot position and FBI-bit position.)		
ID label	**"long"**	**"medium"**	**"short"**
A	0000000(0) 0000000(0)	000(0) 000(0)	000 000
B	1111111(1) 1111111(1)	111(1) 111(1)	111 111
C	0000000(0) 1111111(1)	000(0) 111(1)	000 111
D	1111111(1) 0000000(0)	111(1) 000(0)	111 000
E	0000111(1) 1111000(0)	001(1) 110(0)	001 100
F	1111000(0) 0000111(1)	110(0) 001(1)	110 011
G	0011110(0) 0011110(0)	011(0) 011(0)	010 010
H	1100001(1) 1100001(1)	100(1) 100(1)	101 101

From the table 1, we see that the minimum Hamming distance of ID codes for 1 bit FBI is:

- d_{min} = 7 for long code of length 15
- d_{min} = 4 for medium code of length 8
- d_{min} = 3 for punctured medium code of length 7
- d_{min} = 2 for short code of length 5

And from table 2, the minimum Hamming distance of ID codes for 2 bit FBI is:

- d_{min} = 8 for long code of length 16
- d_{min} = 6 for punctured long code of length 14
- d_{min} = 4 for medium code of length 8
- d_{min} = 2 for punctured medium code of length 6
- d_{min} = 2 for short code of length 6

3. Proposed ID codes

The followings are proposed SSDT cell ID codes and we see there is benefit in terms of minimum Hamming distance.

Table 3: Settings of ID codes for 1 bit FBI (Proposed)

ID label	ID code "long"	"medium"	"short"
A	000000000000000	(0)0000000	00000
B	101010101010101	(0)1010101	01001
C	011001100110011	(0)0110011	11011
D	110011001100110	(0)1100110	10010
E	000111100001111	(0)0001111	00111
F	101101001011010	(0)1011010	01110
G	011110000111100	(0)0111100	11100
H	110100101101001	(0)1101001	10101

Table 4: Settings of ID codes for 2 bit FBI (Proposed)

ID label	ID code (Column and Row denote slot position and FBI-bit position.) "long"	"medium"	"short"
A	(0)0000000 (0)0000000	(0)000 (0)000	000 000
B	(0)0000000 (1)1111111	(0)000 (1)111	000 111
C	(0)1010101 (0)1010101	(0)101 (0)101	101 101
D	(0)1010101 (1)0101010	(0)101 (1)010	101 010
E	(0)0110011 (0)0110011	(0)011 (0)011	011 011
F	(0)0110011 (1)1001100	(0)011 (1)100	011 100
G	(0)1100110 (0)1100110	(0)110 (0)110	110 110
H	(0)1100110 (1)0011001	(0)110 (1)001	110 001

From the table 3, we see that the minimum Hamming distance of proposed ID codes for 1 bit FBI is:

- d_{min} = 8 for long code of length 15
- d_{min} = 4 for medium code of length 8
- d_{min} = 4 for punctured medium code of length 7
- d_{min} = 2 for short code of length 5

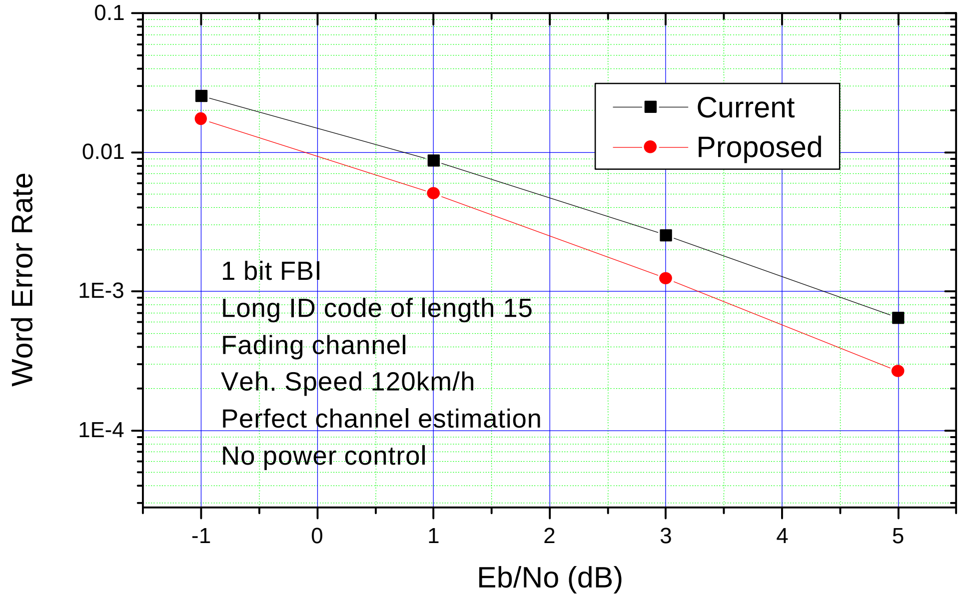
And from table 2, the minimum Hamming distance of ID codes for 2 bit FBI is:

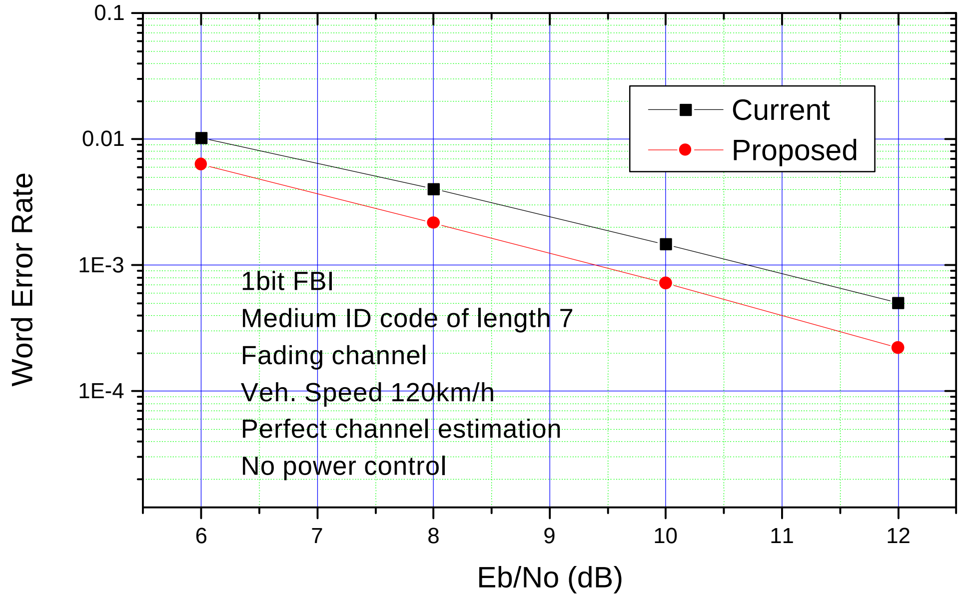
- d_{min} = 8 for long code of length 16
- d_{min} = 7 for punctured long code of length 14
- d_{min} = 4 for medium code of length 8
- d_{min} = 3 for punctured medium code of length 6
- d_{min} = 3 for short code of length 6

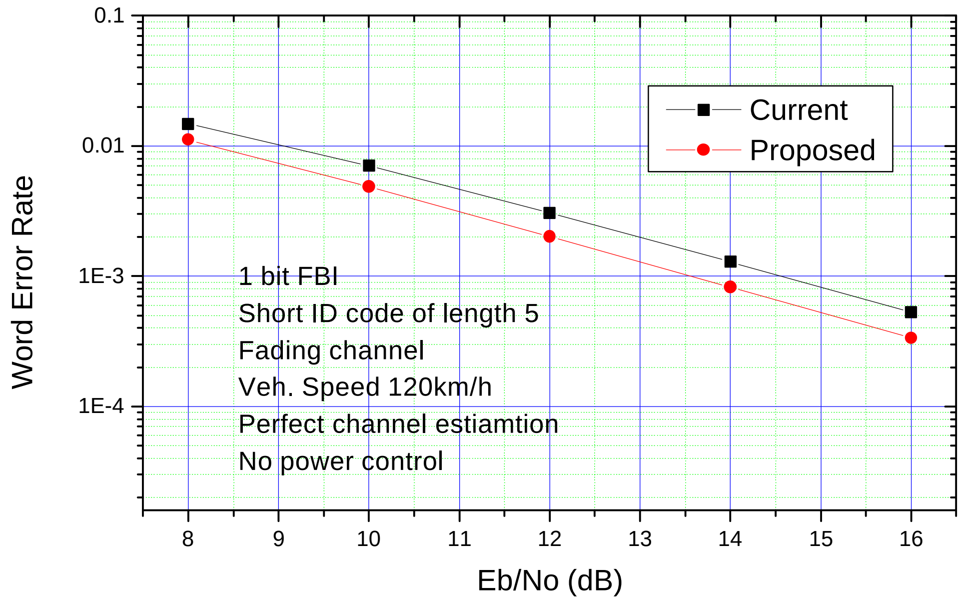
4. Performance evaluation

- **Fading Channel (1 bit FBI)**

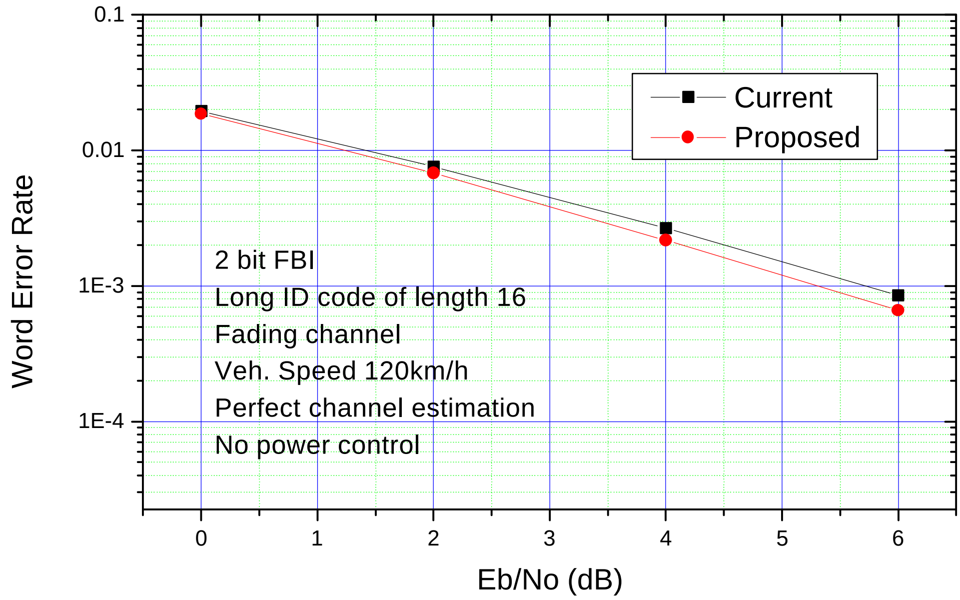
Simulation condition:
- 1path
- Perfect channel estimation
- No power control
- Vehicular Speed = 120km/h

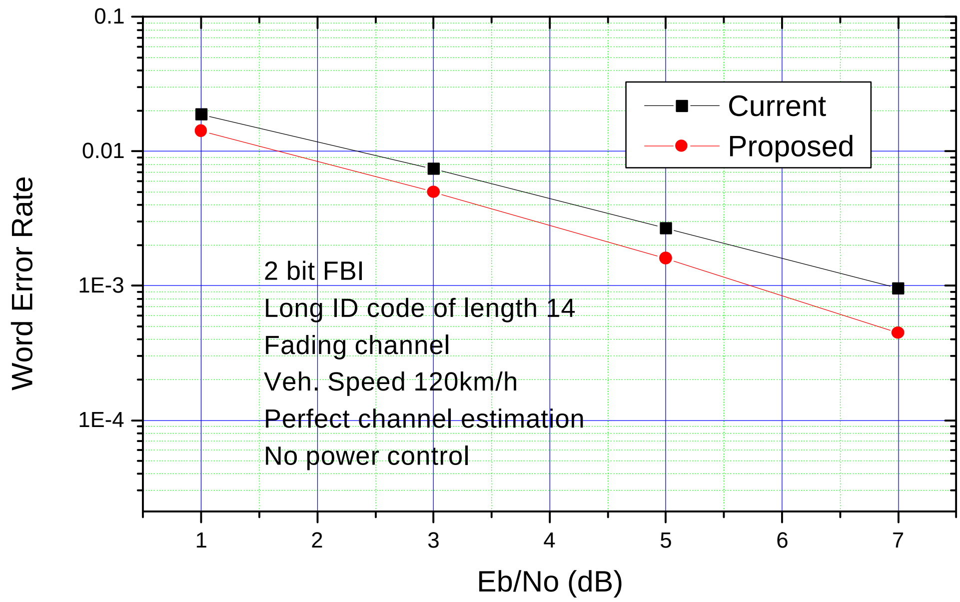


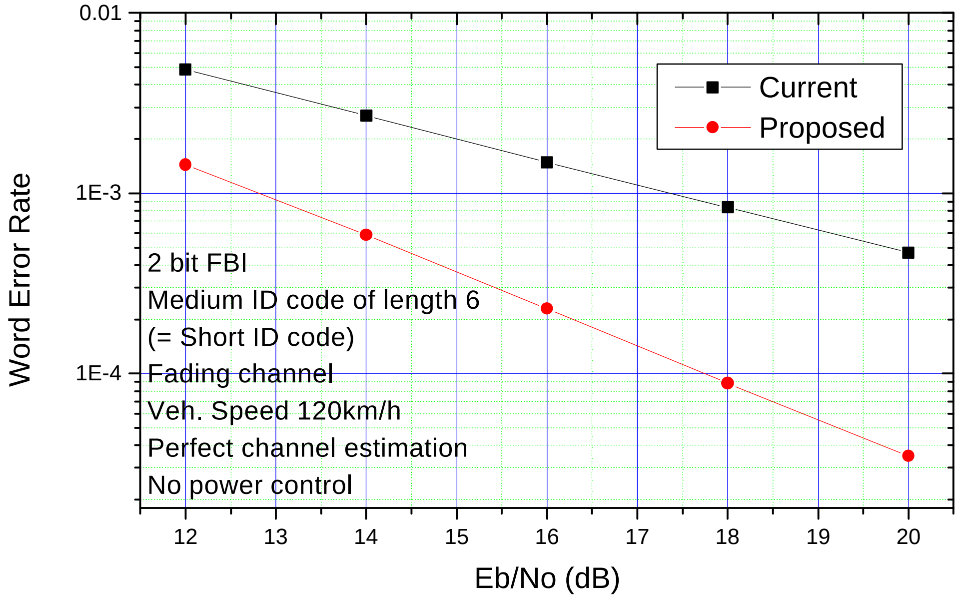

Word Error Rate
Eb/No (dB)
Current
Proposed
1bit FBI
Medium ID code of length 7
Fading channel
Veh. Speed 120km/h
Perfect channel estimation
No power control


Word Error Rate
Eb/No (dB)
Current
Proposed
1 bit FBI
Short ID code of length 5
Fading channel
Veh. Speed 120km/h
Perfect channel estiamtion
No power control

- **Fading channel (2 bit FBI)**







5. Conclusion

In this contribution, we proposed the new optimized ID code for SSDT and we found that there is significant performance gain compared to the current ID codes. There is approximately 4.5dB performance gain at 10^{-3} word error rate when 2 bit FBI is used and approximately 1.5dB gain at 10^{-3} word error rate when 1 bit FBI is used in fading channel. The proposed SSDT cell ID codes have high commonality among the codes and the decoder can be easily implemented by using FHT.

References

[1] "UTRA FDD ; Physical layer procedures", 3GPP TS25.214, v3.1.0 (1999-12).

[2] LGIC, "Optimum ID Codes for SSDT", TSGR1#9(99)K76

[3] LGIC and Samsung, "Proposed LS on Higher Layer Signaling for Site Selection Diversity Transmission Power Control", TSGR1#9(99)L49.

[4] WG1, "Proposed LS on Higher Layer Signaling for Site Selection Diversity Transmission Power Control", TSGR1#9(99)L74.

[5] WG3, "Response to LS on Higher Layer Signaling for Site Selection Diversity Transmission Power Control", TSGR1-00-0008.

3GPP TSG RAN WG1 Meeting #10
Beijin, China, Jan 18 – 21, 2000

Document R1-00-0012
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

Please see embedded help file at the bottom of this page for instructions on how to fill in this form correctly.

25.214	**CR**	**043**	Current Version: 3.1.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to:	TSG-RAN #7	for approval	X	strategic		(for SMG use only)
list expected approval meeting # here ↑		for information		Non-strategic		

Form: CR cover sheet, version 2 for 3GPP and SMG The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc

Proposed change affects: *(at least one should be marked with an X)*	(U)SIM		ME	X	UTRAN / Radio	X	Core Network	

Source:	LGIC	**Date:**	2000-1-8
Subject:	Optimum ID Codes for SSDT Power Control		
Work item:			

Category:	F	Correction	X	**Release:**	Phase 2	
	A	Corresponds to a correction in an earlier release			Release 96	
(only one category	B	Addition of feature			Release 97	
shall be marked	C	Functional modification of feature			Release 98	
with an X)	D	Editorial modification			Release 99	X
					Release 00	

Reason for change:	The current ID codes for SDDT power control is not optimised. This CR corrects the codes.
Clauses affected:	5.2.1.4

Other specs affected:	Other 3G core specifications		→ List of CRs:	
	Other GSM core specifications		→ List of CRs:	
	MS test specifications		→ List of CRs:	
	BSS test specifications		→ List of CRs:	
	O&M specifications		→ List of CRs:	

Other comments:	

5.2.1.4 Site selection diversity transmit power control

5.2.1.4.1 General

Site selection diversity transmit power control (SSDT) is an optional macro diversity method in soft handover mode.
Operation is summarised as follows. The UE selects one of the cells from its active set to be 'primary', all other cells are classed as 'non primary'. The main objective is to transmit on the downlink from the primary cell, thus reducing the interference caused by multiple transmissions in a soft handover mode. A second objective is to achieve fast site selection without network intervention, thus maintaining the advantage of the soft handover. In order to select a primary cell, each cell is assigned a temporary identification (ID) and UE periodically informs a primary cell ID to the connecting cells. The non-primary cells selected by UE switch off the transmission power. The primary cell ID is delivered by UE to the active cells via uplink FBI field. SSDT activation, SSDT termination and ID assignment are all carried out by higher layer signalling.

5.2.1.4.1.1 Definition of temporary cell identification

Each cell is given a temporary ID during SSDT and the ID is utilised as site selection signal. The ID is given a binary bit sequence. There are three different lengths of coded ID available denoted as "long", "medium" and "short". The network decides which length of coded ID is used. Settings of ID codes for 1-bit and 2-bit FBI are exhibited in table 3 and table 4, respectively.

Table 3: Settings of ID codes for 1 bit FBI

ID label	ID code		
	"long"	"medium"	"short"
a	000000000000000	~~0000000(0)~~ (0)0000000	00000
b	~~111111111111111~~ 101010101010101	~~1111111(1)~~ (0)1010101	~~11111~~ 01001
c	~~000000001111111~~ 011001100110011	~~0000111(1)~~ (0)0110011	~~00011~~ 11011
d	~~111111110000000~~ 110011001100110	~~1111000(0)~~ (0)1100110	~~11100~~ 10010
e	~~000011111111000~~ 000111100001111	~~0011110(0)~~ (0)0001111	~~00110~~ 00111
f	~~111100000000111~~ 101101001011010	~~1100001(1)~~ (0)1011010	~~11001~~ 01110
g	~~001111000011110~~ 011110000111100	~~0110011(0)~~ (0)0111100	~~01010~~ 11100
h	~~110000111100001~~ 110100101101001	~~1001100(1)~~ (0)1101001	10101

Table 4: Settings of ID codes for 2 bit FBI

ID label	ID code (Column and Row denote slot position and FBI-bit position.) "long"	"medium"	"short"
a	~~0000000(0)~~ ~~0000000(0)~~ (0)0000000 (0)0000000	~~000(0)~~ ~~000(0)~~ (0)000 (0)000	000 000
b	~~1111111(1)~~ ~~1111111(1)~~ (0)0000000 (1)1111111	~~111(1)~~ ~~111(1)~~ (0)000 (1)111	~~111~~ ~~111~~ 000 111
c	~~0000000(0)~~ ~~1111111(1)~~ (0)1010101 (0)1010101	~~000(0)~~ ~~111(1)~~ (0)101 (0)101	~~000~~ ~~111~~ 101 101
d	~~1111111(1)~~ ~~0000000(0)~~ (0)1010101 (1)0101010	~~111(1)~~ ~~000(0)~~ (0)101 (1)010	~~111~~ ~~000~~ 101 010
e	~~0000111(1)~~ ~~1111000(0)~~ (0)0110011 (0)0110011	~~001(1)~~ ~~110(0)~~ (0)011 (0)011	~~001~~ ~~100~~ 011 011
f	~~1111000(0)~~ ~~0000111(1)~~ (0)0110011 (1)1001100	~~110(0)~~ ~~001(1)~~ (0)011 (1)100	~~110~~ ~~011~~ 011 100
g	~~0011110(0)~~ ~~0011110(0)~~ (0)1100110 (0)1100110	~~011(0)~~ ~~011(0)~~ (0)110 (0)110	~~010~~ ~~010~~ 110 110
h	~~1100001(1)~~ ~~1100001(1)~~ (0)1100110 (1)0011001	~~100(1)~~ ~~100(1)~~ (0)110 (1)001	~~101~~ ~~101~~ 110 001

ID must be terminated within a frame. If FBI space for sending a given ID cannot be obtained within a frame, hence if the entire ID is not transmitted within a frame but must be split over two frames, the ~~last~~first bit(s) of the ID is(are) punctured. The relating bit(s) to be punctured are shown with brackets in table 3 and table 4.

5.2.1.4.2 TPC procedure in UE

The TPC procedure of the UE in SSDT is identical to that described in subclause5.2.1.2 or 5.2.1.3 in compressed mode.

5.2.1.4.3 Selection of primary cell

The UE selects a primary cell periodically by measuring the RSCP of CPICHs transmitted by the active cells. The cell with the highest CPICH RSCP is detected as a primary cell.

5.2.1.4.4 Delivery of primary cell ID

The UE periodically sends the ID code of the primary cell via portion of the uplink FBI field assigned for SSDT use (FBI S field). A cell recognises its state as non-primary if the following conditions are fulfilled simultaneously:

- the received primary ID code does not match with the own ID code,
- the received uplink signal quality satisfies a quality threshold, Qth, a parameter defined by the network.
- and, when the uplink link compressed mode, does not results in excessive levels of puncturing on the coded ID. The acceptable level of puncturing on the coded ID is less than (int)N_{ID}/3 symbols in the coded ID (where N_{ID} is the length of the coded ID).

Otherwise the cell recognises its state as primary.
The state of the cells (primary or non-primary) in the active set with update synchronous. If a cell receives the last portion of the coded ID in uplink slot #j, the state of cell is updated in downlink slot#{(j+1+T_{os}) mod 15}. Where T_{os} is defined as a constant of 2 time slots. The updating of cell state is unchanged by the operation of downlink compressed mode.

At the UE, the primary ID code to be sent to the cells is segmented into a number of portions. These portions are distributed in the uplink FBI S-field. The cell in SSDT collects the distributed portions of the primary ID code and then detects the transmitted ID. Period of primary cell update depends on the settings of code length and the number of FBI bits assigned for SSDT use as shown in table 5

Table 5: Period of primary cell update

	The number of FBI bits per slot assigned for SSDT	
code length	**1**	**2**
"long"	1 update per frame	2 updates per frame
"medium"	2 updates per frame	4 updates per frame
"short"	3 updates per frame	5 updates per frame